Performance of Metal Oxide Supercapacitor Electrodes Enhanced by Graphene

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Supercapacitors are characteristic of fast charging-discharging, high power density and long cycle lifetime. They are finding increasing applications in hybrid vehicles, large memory back-up devices and renewable-energy power plants. The material and structure of the electrode is the key to the supercapacitor performance including the power density, the energy density, the rate capability, the charging time and the cyclic stability. Carbon materials as supercapacitor electrodes show high rate capability and excellent long-term cyclic stability. In contrast, metal oxides have high specific capacitance but low rate capability and poor cyclic stability. One effective route to achieve high-performance supercapacitor electrode is to incorporate carbon materials (i.e. active carbon, carbon fibers, carbon nantubes and graphene) with metal oxide to form metal oxide/carbon composites [1].

In this work, the reduced graphene oxide (rGO) has been incorporated with zero-dimensional (0D) and one-dimensional (1D) TiO_2 nanomaterials as the supercapacitor electrodes. It is found that the specific capacitance of rGO-TiO_2 composites is much higher than that of monolithic rGO, TiO_2 nanoparticles (NPs) or nanobelts (NBs). The effects of the mass ratio of rGO:TiO_2 on the electrochemical performance has been investigated. It has been found that the rGO:TiO_2 mass ratio in the rGO-TiO_2 composite is optimized to be 7:3 for both TiO_2 NPs and TiO_2 NBs. In addition, the rGO-TiO_2 NB composite exhibits better performance than the rGO-TiO_2 NP composite in terms of specific capacitance, rate capability, energy density and power density. The better performance of the rGO-TiO_2 NB composite is attributed to the nanobelt's unique shape, better charge transport property and larger area of contact with the rGO nanosheets [2].

References

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